

TERRAIN AND INTELLIGENCE

COLLECTION

A Monograph
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ABSTRACT

Terrain and Intelligence Collection by MAJ Todd A. McGill, USA, 54 pages.

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The US Army developed the tactical intelligence systems now in use to support high intensity combat operations against the Soviet Union during the Cold War. Since the disappearance of the Soviet Union and the rapid change in the world balance of power, the US Army has had to make do with systems designed and procured for a struggle between superpowers. The interaction between terrain and climate often place different demands on MI units than those found in Central Europe.

The way to increase tactical MI units' capabilities is to modify the current European-focused structures with a more flexible design. The proposed structure would keep the analytical, planning, and production capabilities in the division, but move the collectors to functionally-based battalions in an additional corps MI brigade. The new MI battalion and brigade structures would allow commanders to organize and focus intelligence support the same way they can focus artillery or engineer unit support of the main effort.

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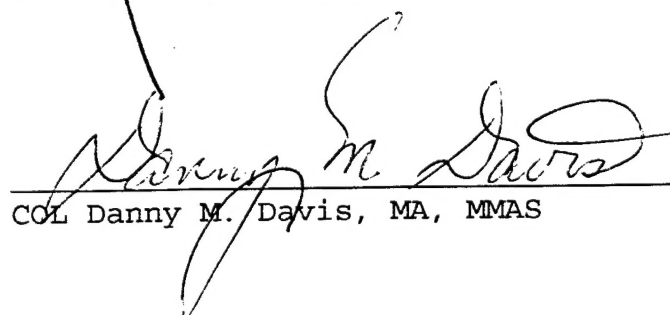
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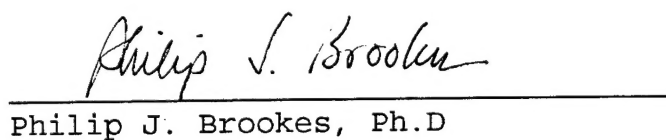
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GLOSSARY

ACE	Analysis and Control Element
AE	Aerial Exploitation
ASAS	All-Source Analysis System
ATCCS	Army Tactical Command and Control System
BDA	Battlefield Damage Assessment
C2	Command and Control
CI	Counterintelligence
CNR	Combat Net Radio
CP	Command Post
DMAIN	Division Main
COMINT	Communications Intelligence
DOCEX	Document Exploitation
DS	Direct Support
EA	Electronic Attack
EAC	Echelons Above Corps
ELINT	Electronic Intelligence
EO	Electro-optical
ES	Electronic Warfare Support
EW	Electronic Warfare
FLIR	Forward Looking Infrared Radar
FLOT	Forward Line of Troops
GBCS	Ground-based Common Sensor
GS	General Support
GSM	Ground Station Module
HHD	Headquarters and Headquarters Detachment
HHOC	Headquarters and Headquarters Operations Company
GSR	Ground Surveillance Radar
HUMINT	Human Intelligence
IEW	Intelligence Electronic Warfare
IMINT	Imagery Intelligence
I&W	Indications and Warning
IR	Intelligence Requirement
IPB	Intelligence Preparation of the Battlefield
IPW	Prisoner of War Interrogation
JSTARS	Joint Surveillance Target Attack Radar System
LOS	Line of Sight
LRSD	Long Range Surveillance Detachment
LRSU	Long Range Surveillance Unit
MASINT	Measuring and Signature Intelligence
MI	Military Intelligence

MITT	Mobile Integrated Tactical Terminal
MSE	Mobile Subscriber Equipment
OPCON	Operational Control
OPS	Operations
OPSEC	Operations Security
OPTEMPO	Operations Tempo
PIR	Priority Intelligence Requirement
REMBASS	Remotely Monitored Battlefield Sensor System
SATCOM	Satellite Communications
SIGINT	Signals Intelligence
SLAR	Side Looking Airborne Radar
TE	Tactical Exploitation
TECHINT	Technical Intelligence
TSQ	Technical Surveillance Equipment
UAV	Unmanned Aerial Vehicle

Introduction

The purpose of this paper is to look at the current capabilities of division and corps Military Intelligence (MI) units and their ability to provide intelligence in differing geographical settings. The geographical environments considered include the general terrain and climate of the desert, jungle, mountain, and urban areas. The hypothesis of this paper is that the constraints imposed by these differing geographic environments are at odds with the mix of the collection and dissemination capabilities found in tactical MI organizations responsible for executing the intelligence cycle in support of commanders.

The US Army developed the intelligence collection and dissemination systems now in use to support high intensity combat operations against the Soviet Union during the Cold War. The mission of defending Europe from attack was for many years the primary mission and worst case scenario for which the Army planned.¹ The geographic focus of preparations for the potential conflict was Central Europe. Since the disappearance of the Soviet Union and the resulting rapid change in the perceptions of power in the world, the US Army has had to make do with systems designed and procured for a struggle between superpowers. The worst case scenario which drove force planning for years has been replaced by combat deployments to other regions. This

change in mission focus has had a great impact on military intelligence operations:

"One of the most dramatic lessons of recent limited wars is that Western threat assessment technologies have a number of shortcomings when they are used against unsophisticated opponents. Most Western threat assessment technologies are designed to be used against technologically advanced forces, such as those of the Soviet Union and Eastern Europe, and many have limited value in dealing with low-level wars."²

When systems designed and organized for a high intensity conflict in Europe are transferred to other areas of the world, how are they influenced by these new geographic characteristics? The interaction between terrain and climate place different demands on MI units than was often found in Central Europe. Combat operations taking place in other geographic regions of the world consequently place demands on the process of intelligence collection and dissemination that MI units are finding difficult to support. The impact of differing geographic environments is great enough that current tactical MI organizations should be modified. The way to increase tactical MI unit collection capabilities is to modify the current European-focused structures with a more flexible design. New MI battalion and brigade structures would allow commanders to organize and focus intelligence support the same way he can focus artillery or engineer unit support.

The MI units analyzed in this paper provide tactical and operational intelligence. The Army defines tactical intelligence as analyzed information that a commander needs to support the execution of battles and engagements.³ This analyzed information allows the commander to focus combat power against enemy forces to achieve his objectives. Tactical intelligence differs from other types of intelligence with regard to the speed in which it is needed by its consumers. Such intelligence can immediately influence the outcome of a mission, but it rapidly loses its value as combat progresses. Tactical intelligence generally supports operations by echelons at and below corps. Operational intelligence supports the planning and execution of campaigns and major operations. It serves as a bridge between the strategic and tactical levels and supports the needs of commanders from theater through corps and joint task forces.⁴

Characteristics of Effective Intelligence

Effective intelligence has several characteristics.⁵ Intelligence needs to be usable, timely, available, and balanced (See Figure 1).

Intelligence Characteristics

Usable: The intelligence meets the specific needs of the requestor. The products requested are in an easily usable graphic or textual format. They explain their own significance.

Timely: The intelligence is provided early enough to influence planning and execution of operations. The products are delivered when directed. Arrives in time to prevent surprise.

Available: Intelligence assets are maintained at a high state of readiness, are able to understand potential adversaries, and capable of producing and disseminating usable intelligence.

Balanced: The intelligence is derived from multiple sources and disciplines to minimize the possibility of deception or misinterpretation.

Figure 1.

The first characteristic is the **usability** of intelligence. Usability involves these questions: Is the intelligence delivered in a useful format? Does terrain limit the usability of the collected intelligence? Can the information be disseminated in a graphic format? The second characteristic is the **timeliness** of intelligence. For intelligence to be timely it must be disseminated to the right echelon in time to allow effective action to be based upon it. Does the terrain affect the speed of collection or dissemination? The third characteristic of effective intelligence is **availability**. Availability of intelligence involves the questions of whether or not intelligence assets

necessary to collect the information are available and whether or not the commander shares or owns an asset. Does the terrain limit a collector's ability to access a target or disseminate the intelligence? The last characteristic is **balance**. Does the terrain unbalance the relationship between differing collection disciplines? Can the information be collected from multiple sources? Does the terrain favor a particular type of collection or dissemination system? As the foregoing discussion indicates, differing terrain can have a major impact on the quality and effectiveness of intelligence.

The Intelligence Cycle

Intelligence operations follow a five-step process known as the intelligence cycle (See Figure 2).⁶ This cycle focuses on the commander's mission and concept of the operation. The overarching principle of the cycle is synchronization.⁷

The Intelligence Cycle

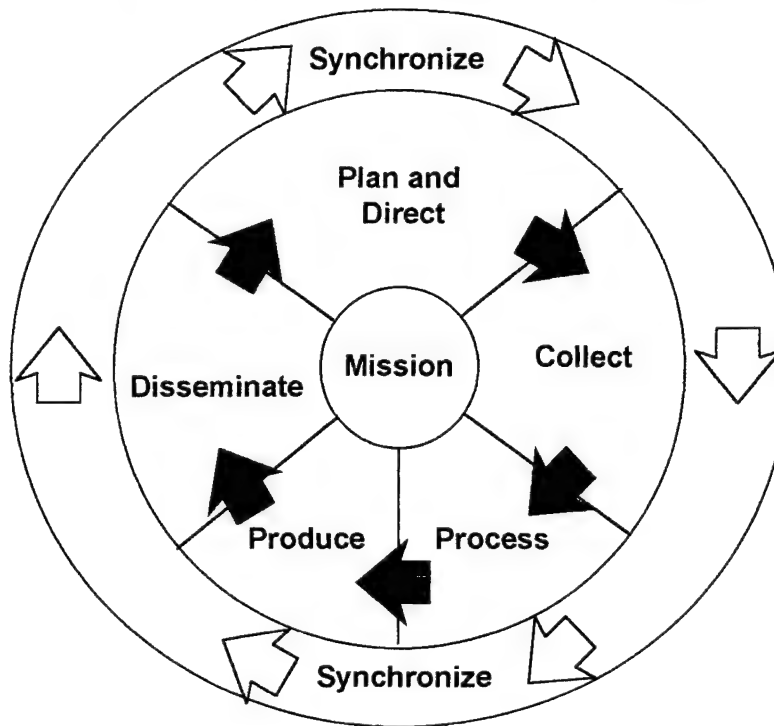


Figure 2.

The intelligence cycle is a continuous process of both simultaneous and sequential steps by which intelligence units support the mission.

In the Plan and Direct phase, senior intelligence officers focus and direct the remaining steps of the cycle.⁸ This is the phase in which the initial intelligence preparation of the battlefield is conducted. This phase includes the development of the initial intelligence estimate. MI planners identify personnel, logistics, and communications requirements while organizing their MI assets for combat. Planners also develop, prioritize, and validate the commander's priority intelligence requirements (PIRs)

and additional intelligence requirements (IRs). They also develop a collection plan and an intelligence synchronization matrix. In brief, this is the point at which the MI unit receives its mission and determines how to accomplish it. The remaining phases normally occur during mission execution.

The collection phase centers on acquiring information through various sensors and providing this information to processing and production elements. It includes the positioning of intelligence assets to satisfy collection objectives.⁹ The information acquired in this phase is in its rawest form although it can be passed directly on as combat information to an operator for use.

The processing phase takes collected information and converts it into a usable form that can be readily used to produce intelligence.¹⁰ This includes the translation of foreign language materials, electro-optical (EO) and photographic development, and data conversion of radar parameters. Effective management of processing insures that critical information is extracted and made available for analysis.

The production phase is the best-known phase of the intelligence cycle. It involves the integration, evaluation, analysis and synthesis of information into intelligence.¹¹ At the tactical level, the time constraints and tempo of the battle often merge the processing and production phases of the intelligence cycle.

The final phase of the intelligence cycle is the dissemination phase, the timely communication of intelligence to users in a useful form.¹² Emphasis is on insuring that the intelligence is presented so that the user can quickly grasp its importance and then rapidly internalize it.

Military intelligence personnel execute the intelligence cycle's phases in a continuous process. They often execute the phases simultaneously rather than sequentially. For example, as the mission progresses, collection and processing could be going on while the commander and his staff are creating and validating new PIRs.

Intelligence Tasks

The intelligence cycle supports accomplishment of the commander's requirements through the carrying out of six primary intelligence tasks (See Figure 3).¹³

Six Tasks of Army Intelligence

Indications and Warning (I&W): Uses intelligence for early warning to prevent surprise through anticipation and reduce the risk from enemy actions that are counter to planning assumptions.

Intelligence Preparation for the Battlefield (IPB): Uses intelligence to understand the battlefield and the options it presents to friendly and threat forces.

Situation Development: Uses intelligence to provide an estimate of the enemy's combat effectiveness and in helping to understand the battlefield, thereby reducing risk and uncertainty during execution.

Target Development and Support to Targeting: Used to provide intelligence in target development to effectively employ lethal fires or nonlethal electronic attack.

Force Protection: Uses intelligence to identify, locate, and target an enemy's ability to target and affect friendly forces, facilities, and operations.

Battle Damage Assessment (BDA): Uses intelligence to support the assess phase of the targeting process.

Figure 3.

The six intelligence tasks are executed simultaneously. Developed intelligence is applied toward one of these six tasks. Each places different demands on the IEW system though they all use the same intelligence collectors and dissemination systems.

To support the commander, MI units gather information and produce intelligence by executing the six intelligence tasks. The combat information needed for processing to meet the requirements these tasks generate is gathered by intelligence collectors. These collectors' operation and data are defined by one of four intelligence disciplines.

The US Army defines these four broad disciplines as: Human Intelligence (HUMINT), Imagery Intelligence (IMINT), Signals Intelligence (SIGINT) and Measurement and Signature Intelligence (MASINT) (See Figure 4).¹⁴

Intelligence Disciplines

Imagery Intelligence (IMINT): Intelligence information derived from the collection by visual photography, infrared sensors, lasers, electro-optics, and radar sensors wherein images of objects are reproduced optically or electronically on film, electronic display devices or other media.

Signals Intelligence (SIGINT): Intelligence information comprising all communications intelligence, electronics intelligence, and telemetry intelligence. SIGINT results from collecting, locating, processing, analyzing, and reporting intercepted communications and noncommunications.

Human Intelligence (HUMINT): Intelligence information derived from the use of human beings as both sources and collectors, and where the human being is the primary collection instrument.

Measurement and Signature Intelligence (MASINT): Scientific and technical information obtained by quantitative and qualitative analysis of data derived from specific technical sensors for the purpose of identifying any distinctive features associated with the source, emitter, or sender and to facilitate subsequent identification.

Figure 4.

These disciplines serve to define the sources of the information collected and to describe the personnel who specialize in its collection or analysis. For intelligence operations to be effective and reduce the threat's ability to deceive US forces, intelligence collection must effectively use all four disciplines.¹⁵ Each has strengths and weaknesses as far as the reliability, timeliness, and

quality of the intelligence that it provides. The disciplines should complement each other as it is unlikely that a single discipline will provide a comprehensive picture of the threat. Each discipline will produce bits and pieces of information which analysts will fuse and synthesize to produce a complete picture.

In addition there are two multidisciplinary intelligence functions, Counterintelligence (CI) and Technical Intelligence (TECHINT), which operate across the four disciplines (See Figure 5).¹⁶

Intelligence Disciplines Multidiscipline Functions

Counterintelligence (CI): Activities concerned with identifying and counteracting the threat posed by hostile intelligence services or organizations or by individuals engaged in espionage, sabotage, or subversion. The essence of the Army's CI mission is force protection.

Technical Intelligence (TECHINT): The product resulting from the collection, evaluation, analysis, and interpretation of foreign scientific and technical information which covers: a. foreign developments in basic and applied research and in applied engineering techniques; and b. scientific and technical characteristics, capabilities, and limitations of all foreign military systems, weapon systems, and material, the research and development related thereto, and the production methods employed for their manufacture.

Figure 5.

Counterintelligence operations focus primarily on the task of force protection, denying the enemy knowledge of our

activities and working to promote Operations Security (OPSEC) throughout the organization. TECHINT focuses on providing intelligence for I&W tasks. The technical information gathered and generated on foreign weapons systems and production facilities helps to insure that the US Army does not suffer operational or tactical surprise from unknown weapons systems. Additionally, analysts use intelligence on foreign systems in characterizing future threats, thereby helping to define our own weapons procurement requirements.

Military Intelligence Units

The US Army organizes MI units to provide a multidiscipline intelligence effort so as to enable commanders to understand the battlefield, anticipate the battle, and influence the outcome of operations.¹⁷

The MI units discussed herein are the heavy division MI battalion and the corps MI brigade.¹⁸ The divisional MI battalion is currently organized around a Headquarters & Headquarters Operations Company (HHOC), three Direct Support Companies (one for each ground maneuver brigade in the division), a General Support Company, and an OPCON flight platoon from the Aviation Brigade (See Figure 6).

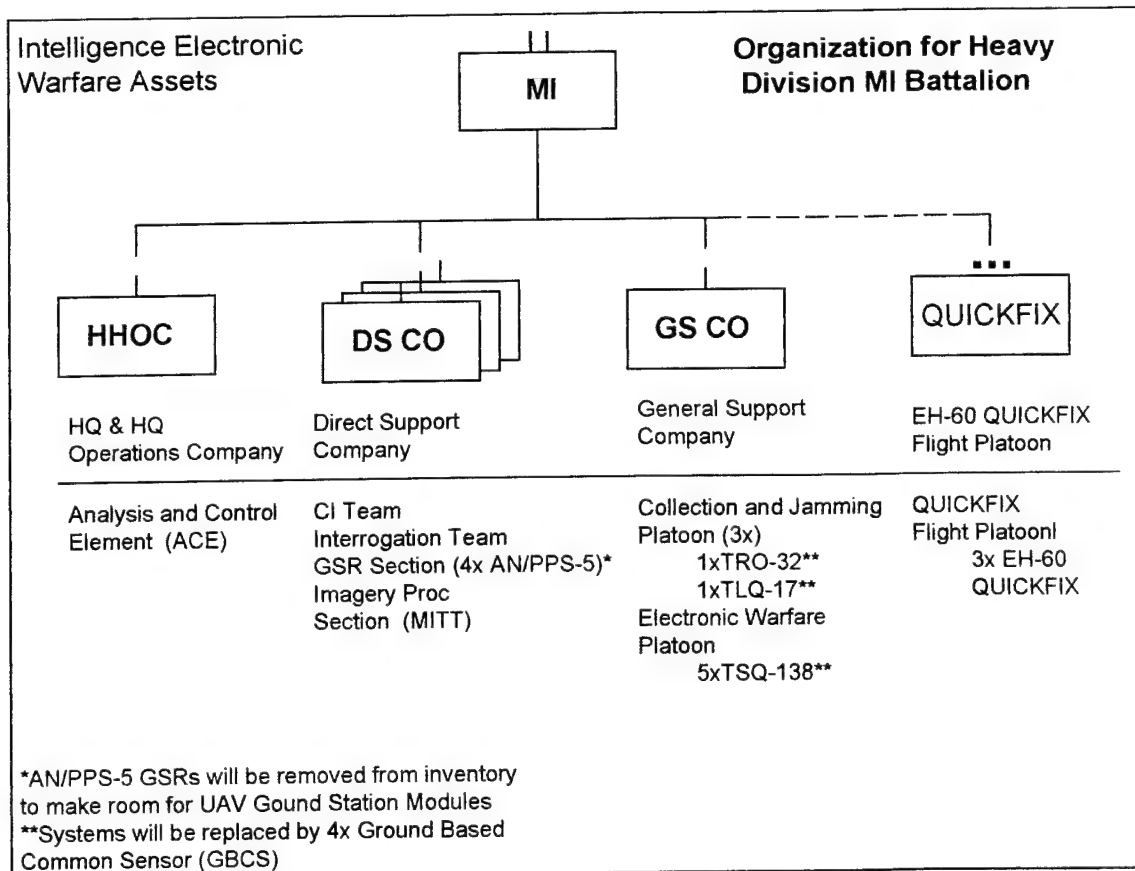


Figure 6.

The support for the I&W and IPB functions of the division are found in the HHOC. The Analysis and Control Element (ACE) is found within this company.¹⁹ It provides the processing, production, and intelligence dissemination support for the division G-2. The mission of the ACE is to produce and disseminate intelligence and focus collection resources to provide information to the commander. The All Source Analysis System (ASAS) is the primary tool of the ACE. ASAS is a modular, computer-assisted IEW processing, analysis, reporting, and technical control system.²⁰ A primary mission is to provide automated intelligence support to the G2 Plans and Operations staff elements. It is also

the IEW component of the future Army Tactical Command and Control System (ATCCS) and can communicate and exchange data with Joint and National intelligence data bases.

The Direct Support (DS) Company is organized to support the situation development, target development, and force protection intelligence tasks of the supported brigade. It contains CI and IPW interrogator teams, a Ground Surveillance Radar (GSR) Section, and an Imagery Production Section. The latter uses a Mobile Integrated Tactical Terminal (MITT) to provide multiple-source SIGINT and secondary IMINT dissemination to the supported brigade. The arrival of an Unmanned Aerial Vehicle (UAV) ground station module (GSM) will eventually replace the GSR section and allow the brigade direct access to the EO/FLIR imagery collected by the division's UAVs.²¹ The DS company does not contain any electronic warfare assets. It has tactical CI and HUMINT collectors, and a tactical IMINT collector with GSR's or UAV GSMs. The tactical IMINT collectors provide a minimal force protection and target development capability. Additionally, the MITT provides access to SIGINT and IMINT information from theater and national intelligence collectors. Finally, the ASAS terminal provides the brigade access to the entire intelligence resources of the division.

The General Support (GS) Company provides the division with its Electronic Warfare (EW) capability. The GS company supports the division in fulfilling the intelligence tasks of indications and warning, situation development, and

target development and support to targeting. The GS company also allows the division to conduct Electronic Attack (EA) and Electronic Warfare Support (ES). ES systems are communications intelligence collectors in that they intercept and process communications passed by radio.²² The TLQ-17s are the only ground-based electronic attack asset in the division and can also conduct COMINT collection. In the future, four Ground Based Common Sensor (GBCS) systems will replace current COMINT and EA assets; GBCS will also provide ELINT collection.

The GS company is scheduled to receive a UAV platoon of six UAVs with support equipment that will allow UAV-collected information to be down-linked directly to maneuver brigades and selected command posts. Additionally, beginning in 1998 the GS company will receive six Ground Station Modules (GSM) to enable the division to receive and process Joint-Surveillance Target Acquisition Radar System (JSTARS) information. Normally the three ground maneuver brigades and the aviation brigade will receive a GSM as will the division main and tactical command posts.

The final divisional MI battalion asset is the QUICKFIX Flight Platoon. The platoon is organic to the division's aviation brigade but is always OPCON to the MI battalion for operations. The platoon has three EH-60 QUICKFIX helicopters that can conduct COMINT collection and electronic attack. Advanced versions will be able to conduct ELINT collection as well.²³

The MI battalion found in a light division (See Figure 7) has a HHOC and DS company nearly identical to that in the heavy division. The DS company has smaller, shorter range PPS-15 radars and a Remotely Monitored Battlefield Sensor System (REMBASS) section. REMBASS is a MASINT collector, an unattended ground sensor system that detects, classifies and determines the direction of movement of intruding vehicles and personnel.²⁴ The GS company has a Document Exploitation (DOCEX) Team to translate and exploit captured enemy documents. It does not have the track-mounted TSQ-138 TRAILBLAZER system. It instead, operates the AN/PRD-12 manportable COMINT intercept and direction finding system. The light division does not have TLQ-17 jamming systems and so cannot conduct ground-based electronic attack operations. In the future the light division will receive GBCS, UAVs, and JSTARS GSMS in lightweight wheeled configurations, giving it SIGINT and IMINT collection capability similar to the heavy division. The Long Range Surveillance Detachment (LRSD) is found only in light divisions. The detachment has four 6-man teams that can be inserted up to 150 kilometers in front of the forward line of troops (FLOT).

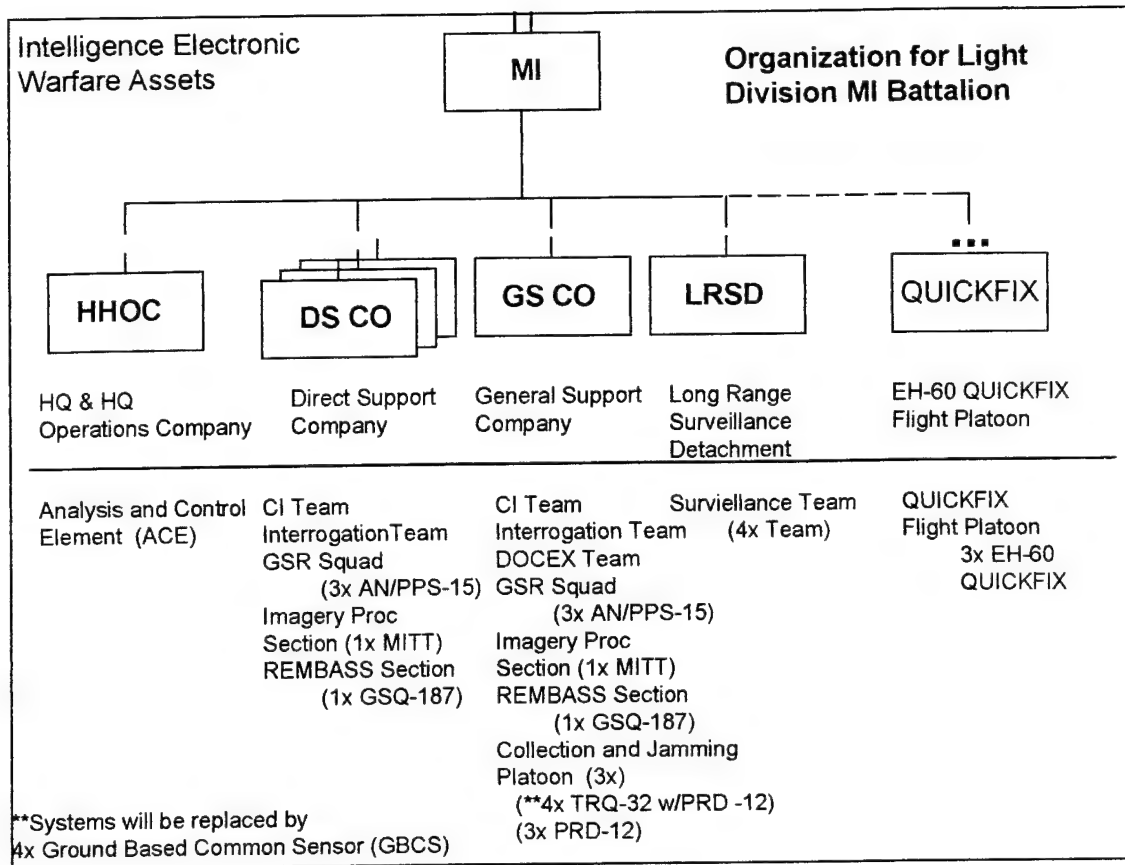


Figure 7.

Each US Army corps has a tactical MI brigade. The MI brigade is the largest tactical intelligence organization and conducts IEW operations in support of the corps commander. The MI brigade has a Headquarters & Headquarters Detachment (HHD), an Operations battalion, two Tactical Exploitation (TE) battalions (one active duty, the other reserve component) and an Aerial Exploitation (AE) battalion (See Figure 8).

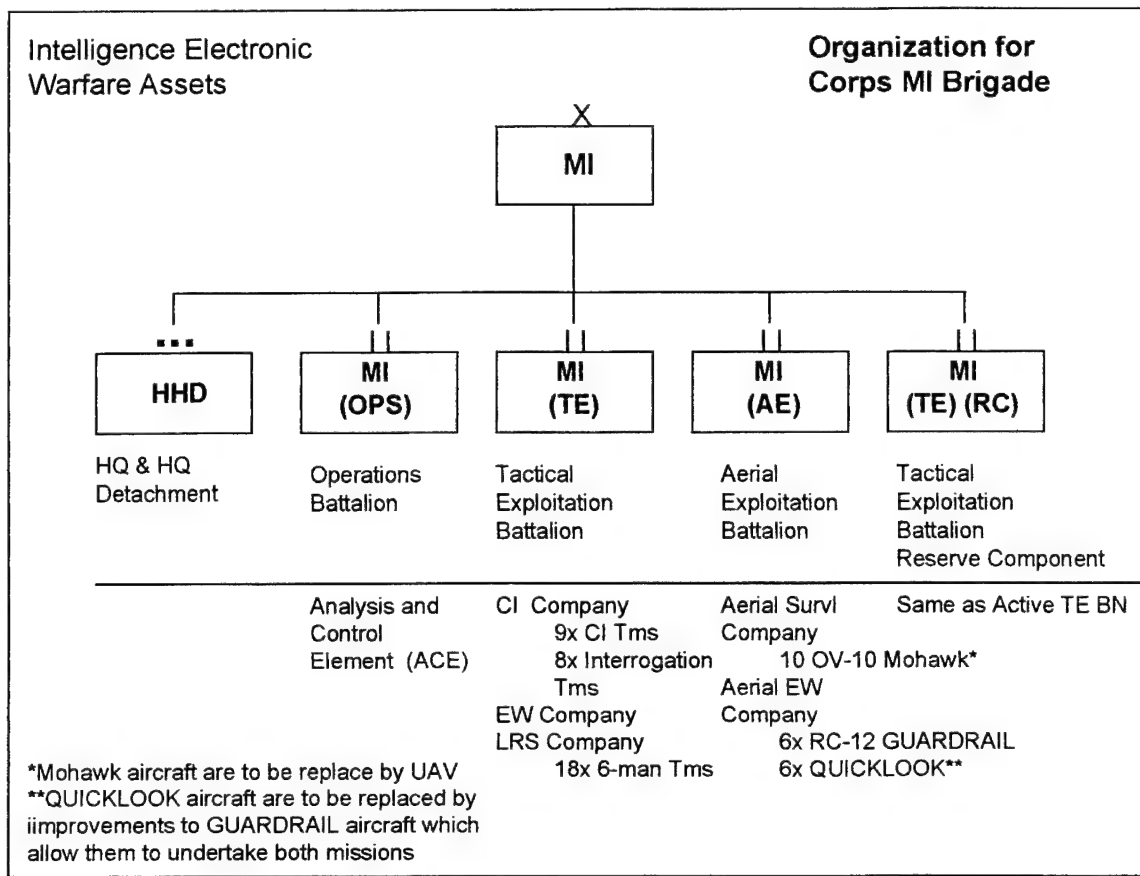


Figure 8.

The organization of the MI brigade is similar to the MI battalion found in a division. A small Headquarters and Headquarters detachment (HHD) provides command and control to the brigade. The Operations (OPS) Battalion performs the IEW management for the corps G-2 staff with its corps ACE and ASAS systems. The battalion executes indication and warning, situation development, target development, and battle damage assessment for the corps. The corps ACE normally collocates with the corps main command post.

The Tactical Exploitation (TE) Battalion provides CI, IPW and ground-based COMINT support to the corps in the same manner that the GS company does for the division. The TE

battalion works on the intelligence tasks of indication and warning, situation development, and target development and support to targeting. The GS company also allows the division to conduct Electronic Attack (EA) and Electronic Warfare Support (ES). The EW company contains the same COMINT and electronic attack systems as are found in the heavy division. The corps commander normally uses the TE battalion to weight the main effort. In particular, the corps commander uses IPW interrogators and CI teams to support subordinate units. Otherwise, the TE battalion deploys across the corps front to collect information in support of the corps PIRs and IRs. There is a reserve component MI TE battalion assigned to the MI brigade. This TE battalion has capabilities found in both the OPS and TE battalions of the active component MI brigade. It can provide additional support to the corps ACE from its operations company. There is a CI/Interrogator Company that provides additional CI and interrogator teams, an EW attack company that provides ground-based EA support, and an EW support company that provides additional ground-based COMINT collection. The reserve component TE battalions did not deploy in OPERATION DESERT SHIELD/STORM. The call-up of intelligence soldiers was done on an individual basis, usually for analytical expertise rather than for collection capabilities. The future of the reserve TE organization unclear at this time.

The Aerial Exploitation (AE) battalion is a unique organization that performs aerial SIGINT and EW collection. The unit supports the intelligence tasks of indication and warning, situation development, target development and support to targeting, and force protection. The AE battalion does not conduct EA missions and none of its current systems can conduct cross FLOT missions. The AE battalion also needs an improved runway to operate its aircraft since the RC-12 is a modified civilian aircraft. The 10 OV-1D Mohawk aircraft can conduct SLAR and photo imagery collection, but cannot cross the FLOT.²⁵ The RC-12 GUARDRAIL system is an airborne COMINT intercept and direction finding platform. The Mohawk QUICKLOOK aircraft is an ELINT collection platform. In the future, systems improvements to the GUARDRAIL system will allow it to collect ELINT information and replace the QUICKLOOK aircraft. The UAVs will then replace the QUICKLOOK aircraft in the IMINT collection role. Additionally, JSTARS GSMS in the TE or OPS battalions will provide SLAR collection and reporting.

The Impact of Terrain

Army doctrine identifies several major geographic settings in which US forces will have to be prepared to conduct combat operations.²⁶ These geographic settings include desert, mountain, jungle, and urban landscapes. Each of the environments has seen combat by US forces since the end of WWII. Each has differing impacts on the operation and sustainment of ground forces that in turn affect intelligence collection and dissemination. The terrain and climatic conditions change the collection emphasis between the intelligence disciplines. In one region IMINT might be the most useful source for collection while in another HUMINT provides the best input. The intelligence disciplines collectively contribute to a complete picture of the enemy. The terrain and climatic conditions can limit a particular collector's effectiveness but cannot deny their use.

The Desert Environment

The desert environment is characterized by a lack of moisture and sparse to nonexistent vegetation.²⁷ The climate is very hot and dry with frequent winds and sand storms that blow large amounts of fine soils into the air. There is limited infrastructure other than ports on the periphery of some of these regions. The intense heat and extreme

temperature fluctuations stress both soldiers and equipment
(See Figure 9).

Desert Environment:

The desert supports high-speed, mobile operations and the use of airpower. It hinders sustainment operations, rapidly wearing out men and equipment.

General Characteristics:

- Lack of Moisture (Less than 10 inches of rainfall a year)
- Sparse or non-existent vegetation
- Winds and blowing of non-stabilized soils (Dust Storms)
- Supports only a small human population
- Long Line-of-sight (LOS)
- Intense heat and extreme changes between day and night temperatures

Military Considerations:

- Mechanized ground forces capable of rapid movement across the terrain
- Off road movement extremely difficult for wheeled vehicles
- Few natural chokepoints or key terrain features
- Featureless landscape makes navigation difficult
- Long range fields of fire
- Few clouds, rains, and little fog to obscure sight
- Little concealment (High contrast between man-made objects and terrain)
- Winds and dust storms can limit visibility
- Limited infrastructure (roads, cities, and ports)
- Non-stabilized soils rapidly abrade machinery and electronic components
- Lack of water increases logistics burden

Figure 9.

From a military standpoint, deserts support high speed mobile operations and wide scale use of airpower while hindering resupply operations. The climate and lack of water is a severe hindrance to soldiers' health and equipment performance.

"While the openness of desert terrain typically provides the necessary mobility for armored movements, it facilitates vulnerability to air power....Vast open spaces and clear

skies are highly advantageous to air forces, unhampered by the rough terrain below, except where it provides concealment or protection against air-to-ground weapons.²⁸"

The desert environment has significant impact on the US Army's intelligence collection system (See Figure 10). The terrain significantly favors IMINT collection above other methods. There is very little opportunity for concealment due to the lack of vegetation. The flat terrain and high contrast between the soil and manmade objects make targets readily visible to IMINT collectors.²⁹ IMINT collection is further facilitated by the sparse rainfall and general lack of fog, though the infrequent rains or cloud cover can severely restrict collection opportunities. The vastness of the desert and lack of vegetation favor the use of airborne systems which can take advantage of the long line-of-sight (LOS) distances that exist in the desert.³⁰ The Army will have UAVs in both the MI battalion and MI brigade that can provide IMINT collection and there are communications systems that allow dissemination of IMINT information from other service and national IMINT collectors.

Desert Environment:

Impact on Intelligence Collection:

IMINT: Excellent visibility with little climatic obscuration. Little vegetation to conceal target. High contrast between soils and man-made objects.

SIGINT: Excellent LOS permits collection at maximum ranges. Mobile operations and airpower require the use of radios and radars maximizing collection opportunities. Long distances and vast target areas make asset movement difficult. Airborne platforms are the most useful collectors.

HUMINT: Lack population and vegetation makes collectors vulnerable to detection. Lack of water makes survival difficult. Terrain makes mobility difficult without transport. Force protection against enemy HUMINT much easier for the same reasons.

MASINT: Lack of chokepoints and key terrain limits the ability to usefully employ short range sensors except in force protection role.

Impact on Intelligence Dissemination:

Mobile operations and long transmission ranges make communications difficult. Seldom are multiple communication means in place. There is competition for use of radios; IMINT products demand a very large amount of time and bandwidth to send. Transmission of voluminous SIGINT collection difficult.

Figure 10.

The excellent LOS allows SIGINT collection to occur at systems' maximum ranges. The mobile nature of desert combat operations necessitates the use of radios to maintain adequate command and control (C2). The constant use of radios for C2 gives SIGINT collectors a broad array of targets and numerous opportunities for collection. However, the opportunities for high rates of advance that the desert offers can cause maneuver forces to outrun their MI collection assets. The majority of the Army's SIGINT collectors are ground-based systems mounted on wheeled transport vehicles. The only Army airborne SIGINT collection assets are a platoon in the MI battalion and a company in the MI brigade. The use of airpower in desert

environments enhances ELINT collection. The emission characteristics of radars are unique and can easily be collected, processed and broadcast by ELINT collectors.

The harsh desert environment places many burdens on HUMINT and MASINT collection. The lack of water and the excessive heat make it difficult for HUMINT collectors to sustain themselves long enough to gather useful information. The limited population makes it difficult for these collectors to get close to a target. The CI and force protection tasks are rendered easier by the desert as there are fewer potential enemy HUMINT collectors around and the lack of human habitation makes them easier to spot. The use of ground-based MASINT sensors is limited by the vastness of the terrain which has few chokepoints that can be usefully monitored.

If the desert provides an excellent environment to conduct collection, it places tremendous burdens on intelligence dissemination. The long distances mobile forces cover demand robust communications networks to pass intelligence. In the 1973 War, the Egyptian's initial success and ultimate defeat were in part due to their use of preplanned and organized communications networks that began to fail once they crossed the Suez Canal and attempted to begin mobile operations to exploit their success.³¹

The ACE found in the MI battalion provides fairly robust satellite communications (SATCOM) links to EAC intelligence organizations. However, below division the ASAS

system is reliant on Mobile Subscriber Equipment (MSE) to provide communications links. The amount of data that can flow through this system is limited.³² The division G-2 of the 24th Infantry Division during the war stated:

"Our only significant shortcoming as the ground war neared was in communications... The S-2s and I were nervous about the ability of the multichannel system to serve as our primary communications channel between DMAIN, DTAC, and the maneuver brigades...When a headquarters was moving, we would depend mostly on a thin network of single channel satellite radios linked into a division command and operations net. I could not expect to carry on routine intelligence interchanges on such an austere net."³³

Through SATCOM systems linked into ASAS, the corps and division main command (DMAIN) posts have sufficient communications capability to access and conduct staff dissemination of the intelligence. Forward of the division and brigade main command posts the intelligence dissemination problem grows. Imagery is especially difficult to disseminate as the graphic format demands a tremendous amount of time or bandwidth to send.³⁴ There is not any easy way to get intelligence out of the ASAS or MITT terminals. The MITT and ASAS systems found at the brigade level are very useful for providing access to large quantities of IMINT and SIGINT data and ground order of

battle data for analysis at the brigade command post. However, it is difficult to get the useful intelligence out of the computer and into the hands of the brigade commander or his subordinates as both systems lack a high quality, robust printer capable of quickly producing text or graphics. Below the brigade level, the Mobile Subscriber Equipment communications (MSE) network becomes the only communications system available to send intelligence products. MSE, even with continuing improvements, may not be able to handle the volume of intelligence reporting needed, especially if the intelligence is in a graphic format.

The real issue of intelligence support in desert operations is one of dissemination, not collection.³⁵ The desert terrain encourages a dependence on IMINT and SIGINT systems whose collection characteristics are optimized in this environment. More than 75 percent of the collectors in the MI battalion and MI brigade are IMINT or SIGINT collectors. The few HUMINT collectors are at a disadvantage due to harsh desert environment. MASINT collectors are limited by the desert's vastness and lack of suitable chokepoints except for force protection purposes.

The system of intelligence dissemination is highly stressed due to long transmission ranges and the high operations tempo (OPTEMPO) of the forces. Additionally, the large volume of IMINT and SIGINT products generated is

passed by a very small number of tactical communications systems.

The Jungle Environment

Terrain in the jungle environment is characterized by the extensive and heterogeneous vegetation (See Figure 11).³⁶ The ground is covered by tall broad-leaved trees in a dense canopy often 100 feet above the jungle floor. The resultant shade limits undergrowth, so it is comparatively easy to move on foot, but the trees confine vehicles to few roads. In general, the smaller the spaces between trees, the slower the progress of men and vehicles.³⁷ Where the forest has been slashed and burned for cultivation or logging the secondary growth consists of bush and smaller trees which may be more difficult to penetrate.

Jungle Environment:

The jungle supports dispersed light infantry operations. Vehicular movement is very restricted. The use of airpower is limited except for transport. Sustainment operations are difficult. Lack of vehicular movement complicates resupply. High humidity rapidly degrades the performance of men and equipment.

General Characteristics:

- Torrential rains and high humidity (More than 80 inches of rainfall a year)
- Heavy and dense vegetation (Forest canopies well above the jungle floor)
- Supports only a small human population
- Varied quantities of plant and animal life
- Very short Line-of-sight (LOS)
- Constant high temperatures with little seasonal variation

Military Considerations:

- Heavy vegetation forces dispersion and makes breaking contact easy
- Mechanized ground forces incapable of rapid movement across the terrain
- Off road movement extremely difficult for wheeled vehicles
- Many natural chokepoints
- Short LOS makes navigation difficult
- Very short fields of fire
- Constant rain and fog limit visibility
- Extensive concealment (Forest canopies obscure the true jungle floor)
- Limited infrastructure (roads, cities, and ports)
- High humidity rapidly rusts machinery and damages electronic components
- Water freely available (Only a need to purify)
- Soldiers exposed to a host of biological and microbe threats

Figure 11.

The jungle favors the use of light infantry conducting dispersed operations with airpower used mainly for transport rather than in offensive roles. The concealment that the jungle offers effectively limits the application of air power. It is difficult to find and attack targets with precision. Air operations remain important as they facilitate the movement of forces not otherwise possible given the terrain. The jungle does not favor the employment of armored or mechanized forces. As vehicles are confined to the roads, the speed of the foot soldier sets the operational tempo if roads are left. The terrain forces unit dispersion. The thick vegetation provides concealment,

near point-blank line-of-sight and creates natural chokepoints which channelize movement.³⁸ Additionally, rain and fog obscure visibility.

The jungle also makes logistics a burden. Without helicopter support it is difficult to move men and material. The continual dampness sickens soldiers, degrades electronics components and rapidly rusts exposed metal surfaces. The burden of water supply is eased by its relative abundance, but it still requires purification.

The jungle environment places tremendous burdens on the Army's intelligence system (See Figure 12).

Jungle Environment:

Impact on Intelligence Collection:

IMINT: Limited visibility. Heavy vegetation obscures the terrain and conceals targets.

SIGINT: Poor LOS limits collection. High humidity and vegetation absorb radio transmissions. Dispersed, light infantry operations limit the need for the use of radios, minimizing collection opportunities. Vegetation hampers the placement and movement of assets. Airborne platforms are the most useful collectors.

HUMINT: Heavy vegetation serves to conceal and protect collectors. Water availability makes sustainment easier. Terrain encourages foot movement. Force protection against enemy HUMINT collectors much more difficult for the same reasons.

MASINT: The number of chokepoints and key terrain features promotes the use of such sensors.

Impact on Intelligence Dissemination:

Heavy, dense vegetation makes communications difficult. LOS is often very short demanding multiple retransmission of messages. Emphasis on foot movement limits employment of communications gear. There is competition for use of radios; IMINT products demand a very large amount of time and bandwidth to send. Difficult to contact HUMINT and MASINT collectors to receive information.

Figure 12.

Vegetation greatly limits the IMINT collectors' view of the jungle floor and the constant appearance of rain and fog restricts IMINT coverage. Dense terrain restricts the use of mechanized units (which are the easiest for IMINT to detect and identify). This reduced collection makes IMINT sensors more useful as cueing aids to SIGINT and HUMINT collection systems.

SIGINT collection is also degraded in the jungle. Vegetation absorbs broadcast frequency energy. The absorption decreases radio transmission ranges and reduces radio signatures vulnerability to interception and collection. Vegetation also hinders the placement of collectors (only light divisions having manportable SIGINT collectors). Additionally, jungle combat frequently relies on raids and ambush techniques which do not require an enemy to generate large amounts message traffic. Collection opportunities are therefore limited.³⁹ The reduced reliance on air operations leads to the use of fewer antiaircraft radars. Fewer radars leads to a lesser number of targets for ELINT collection (though the radars become more critical indicators as they tend to cover only high value targets). These limitations result in a dependence on very limited airborne assets of the divisional QUICKFIX platoons or the corps GUARDRAIL company for SIGINT collection. This environment encourages employing the ground-based SIGINT collectors in semifixed positions to provide early warning or targeting support.

The jungle environment offers many opportunities for HUMINT collection. The jungle imposes few restrictions on foot traffic and abundant water is available. Dense vegetation allows small groups or individuals to get close to their reconnaissance targets and the constant movement of animal life and frequent rains help to conceal their presence. Long Range Surveillance Units (LRSU) in corps and light divisions become very useful in this environment. Active patrolling by non-MI units can augment the limited number of LRSU teams. Integrating these HUMINT sources' reports with dedicated MI collectors is difficult but crucial. Additionally, dispersed positioning of units in this environment allows the enemy to get very close before their presence is known making force protection and CI activities more demanding.

MASINT sensors come into their own in the jungle. They can be used offensively to supply targeting information when employed at natural chokepoints along trails and river crossing points. Additionally, there is a much greater demand for their defensive use in the force protection role.

Intelligence dissemination is a struggle in jungle environments. Vegetation shortens broadcast ranges. Restricted LOS places an increased demand on retransmission capabilities and slows the dissemination of intelligence. The light infantry forces which dominate jungle operations do not have ready access to graphic intelligence products through their normal combat net radios (CNR). Only

semipermanent CPs have the communications equipment necessary to receive such intelligence. There is a tremendous need for increased aerial retransmission capabilities. Intelligence briefings prior to active patrolling or other operations take on increased importance in insuring soldiers have the best possible situational awareness, reducing the need to communicate except to provide early warning.

In the jungle environment, more technology-based intelligence collection and dissemination play a less important role than the information provided through the reconnaissance and patrolling conducted by maneuver units. IMINT sensors in particular are disrupted by the jungle's thick vegetation. Their purpose becomes one of cueing other systems. SIGINT collectors have more utility but often have limited LOS and collection ranges. Increased use of airborne SIGINT collectors is key. HUMINT becomes the primary collection means; patrolling and observation by small groups focused on high value targets or known chokepoints pay big dividends. REMBASS systems and other unattended sensors have an offensive targeting role beyond force protection. They can provide early warning and cue other collection systems. This "tip-off" capability is especially useful in maximizing the effectiveness of IMINT collectors. Regardless of the collector, there is a tremendous difficulty in disseminating intelligence. The dispersed nature of jungle combat limits soldiers' ability

to access communications systems other than CNR. Emphasis on pre-mission intelligence briefings, clear mission and commander's intent, and the use of aerial platforms for retransmission and command and control provide some means of negating the impact of this shortcoming.

The Mountainous Environment

If the desert is characterized by lack of water and the jungle by its dense vegetation, the mountainous environment is characterized by its relief (See Figure 13).

Mountainous Environment:

Mountains support mobile operations by light infantry and aviation forces. The terrain greatly restricts vehicular movement in both combat and sustainment operations.

General Characteristics:

- Wide variation in terrain relief
- Numerous peaks and valleys restrict line-of-sight (LOS)
- Rainfall normally limited to less than 30 inches a year
- Wide variation in temperature ranging from hot to frigid
- High winds and altitude restrict aerial operations
- Lack of soil limits the vegetation growth
- Supports only a small human population

Military Considerations:

- Mountains and peaks dominate terrain and channelize movement
- Off road movement extremely difficult for all vehicles
- Numerous natural chokepoints or key terrain
- Restricted fields of fire and LOS
- Limited vegetation for concealment, but broken terrain and relief make it easier
- Winds and altitude inhibit physical activity and limit helicopter lift
- Limited infrastructure (roads, cities, airfields, and ports)
- Lack of open spaces makes base positioning and most construction difficult

Figure 13.

Numerous peaks and valleys with steep gradients greatly restrict movement. Temperatures tend to be cool due to the altitude; in those areas having very high peaks and mountains it can be brutally cold. Winds and altitude restrict aerial operations as aircraft have less lift and turbulence is a problem. Mountain environments offer little to support life; there are few cities or towns in these regions. Those that exist are generally in valleys where suitable land is available.

Peaks and valleys dominate the terrain and channelize almost all movement into valleys. "Light forces and aviation units can operate more effectively in mountainous regions because their movement is less restricted by the terrain."⁴⁰ The result is a series of natural chokepoints that greatly restricts movement. Operations in the mountains are often characterized by forces attacking to seize one chokepoint after another, then denying enemy movement through them.

The rugged nature of mountainous terrain also severely influences intelligence collection (See Figure 14).

Mountainous Environment:

Impact on Intelligence Collection:

IMINT: Good visibility. Rugged terrain can conceal targets. Winds and altitude can restrict air operations

SIGINT: Poor LOS limits collection. Numerous peaks and valleys block or reflect radio transmissions. Light infantry operations limit the need for the use of radios, minimizing collection opportunities. Terrain relief hampers the placement and movement of assets. Airborne platforms are the most useful collectors.

HUMINT: Terrain relief makes concealment easier. Lack of population and vegetation makes collectors vulnerable to detection. Terrain makes mobility difficult without air transport and encourages foot mobility. Force protection against enemy HUMINT influenced by same factors. Limited water makes survival difficult.

MASINT: The number of chokepoints and key terrain features promotes the use of such sensors.

Impact on Intelligence Dissemination:

High peaks and valleys make communications difficult. LOS is often limited, demanding retransmission of messages. Emphasis on foot movement limits employment of communications gear. Difficult to contact HUMINT and MASINT collectors to receive information.

Figure 14.

IMINT collection is restricted by the general limitations the terrain imposes on air operations and the compartmented nature of the terrain. Terrain masking due to the steep peaks and narrow valleys limits line of sight. An IMINT collector must make multiple passes over a given area to insure complete coverage. These multiple collection passes increase the risk of the collector being identified and shot down. Additionally, the IMINT sensor will often have to climb to achieve the LOS necessary to pass its information to the GSM.

The restricted LOS of the mountains also decreases the collection capability of SIGINT systems. The terrain masks emitter signals or reflects them in odd ways which require

additional analysis to be useful. The lack of open spaces in the terrain makes positioning of collectors much more difficult and makes these systems easier to detect. As in the jungle, the slow OPTEMPO and dispersed nature of combat operations further limits SIGINT collection opportunities.

HUMINT collection is very useful in the mountains. Small units can survive on the terrain as long as water is available. However, limited LOS often makes it difficult for them to observe key terrain and also reduces their ability to transmit their sightings. Additionally, the tremendous number of chokepoints and key terrain features rapidly exhausts the limited numbers of MI HUMINT assets. As in the jungle environment, the intelligence most useful to the commander will be that which is collected by maneuver forces conducting their own reconnaissance and security operations. The vulnerabilities of restricted lines of communication make force protection difficult and can take potential HUMINT collection assets away from other tasks.

Numerous natural chokepoints support the use of MASINT collectors. MASINT collectors have problems in transmitting their inputs back for processing and requirements for their use can overwhelm the few sensors that are on hand in light MI battalions.

The limited LOS of the terrain makes dissemination difficult. The compartmented terrain demands numerous retransmission sites to support operations. Lack of open terrain and steep elevations make positioning of area

communications assets like MSE difficult. The most flexible system, combat net radios, is the least capable system and suffers from the terrain masking effects of the mountains. As was the case in jungle terrain, small dispersed units will not have easy access to graphic intelligence products.

The rugged terrain of the mountains restricts both intelligence collection and dissemination. Limited LOS and terrain compartmentation limit IMINT and SIGINT monitoring of targets. HUMINT and MASINT collectors are very useful in this environment but are hindered by their lack of mobility, their reduced ability to communicate, and the sheer number of potential areas to monitor.

The Urban Environment

As lack of water defines the desert and vegetation defines the jungle, human population defines the urban environment (See Figure 15).

Urban Environment:

Occur in any geographical environment. Numerous manmade structures force units to fight in small, decentralized elements. Large civilian populations can create moral dilemmas or concerns over collateral damage and casualties.

General Characteristics:

- Wide variation in relief due to number and type of manmade structures
- Restricted line-of-sight (LOS) due to structures
- Large, dense populations
- Relatively dense infrastructure needed to support population
- Lack of fields or open spaces, limited vegetation

Military Considerations:

- Manmade structures and road networks dominate terrain and channelize movement
- Mechanized ground forces capable of rapid movement
- Road movement extremely difficult for all vehicles
- Numerous manmade chokepoints, obstacles, and key terrain features
- Restricted fields of fire and LOS
- Limited vegetation for concealment, but urban relief makes it easier
- Winds and power/telephone lines impede helicopter flight
- Infrastructure is dense and needs to be controlled or protected
- Lack of open spaces makes unit positioning difficult, but urban structures allow cover and concealment
- Large population presence makes security and use of firepower difficult

Figure 15.

Operationally, the numerous manmade structures force units to fight in small decentralized elements. The infrastructure of the urban landscape makes it easier to employ mechanized forces than in the jungle or mountainous terrain, but channelization often exposes them to ambush. The urban landscape facilitates operations on the ground, on rooftops above the ground, and in the sewers and tunnels below ground. Buildings also create numerous predictable chokepoints and restrict LOS and fields of fire. Antenna and power lines create major obstacles to the employment of helicopters. Finally, the large civilian population makes it difficult to find, characterize, and target enemy forces.

Restrictions on the use of firepower to minimize collateral damage and noncombatant casualties are to be expected.

Intelligence collection has unique challenges in an urban setting (See Figure 16). IMINT collection in an urban setting is very difficult. The numerous structures provide plentiful concealment and climatic conditions such as smog or cooking fires can obscure possible targets. Winds, focused and channeled by buildings, can restrict flying collectors. Additionally, the terrain shadowing of the buildings often demands direct overflight by an IMINT collector, rendering it more vulnerable to ground fire.

SIGINT collection is severely hampered by the urban environment. There is poor LOS which helps to mask emitting targets, thereby limiting collection ranges. The numerous buildings restrict the positioning of most road-bound SIGINT collectors. Large numbers of power sources, such as power lines and generators, are electromagnetically unshielded. They therefore cause interference that degrades SIGINT receiver performance. The use of civilian communications systems limits the ability of SIGINT collectors. Current army tactical SIGINT collectors do not cover the spectrum of cellular phones and the enemy's use of cabled telephone lines eliminates any collectable emanations from that spectrum.

Urban Environment:

Impact on Intelligence Collection:

IMINT: Visibility often poor due to climate or urban pollution (smog). Numerous manmade structures can conceal targets. Winds and manmade obstacles (antennas and powerlines) can restrict air operations

SIGINT: Poor LOS limits collection. Numerous manmade structures block or reflect radio transmissions. Numerous electrical power sources can obscure electromagnetic spectrum. Civilian communications and transportation systems and can limit the the need for the use of radios, minimizing collection opportunities. Manmade structures hamper the placement of assets. Ground-based platforms are the most useful collectors.

HUMINT: Numerous structures make concealment easier. Dense population makes it easier for collectors to operate. Terrain makes mobility difficult without air transport and encourages foot mobility. Force protection against enemy HUMINT is very difficult due to large civilian population.

MASINT: The number of chokepoints and key terrain features promotes the use of such sensors, though dense population increases the amount of information to be processed.

Figure 16.

HUMINT collection in an urban setting has many challenges. Buildings offer excellent cover and concealment but also limit LOS and so restrict a collector's coverage. The dense population makes it very difficult for HUMINT collectors to escape detection. The same population conceals potential threats and makes CI and force protection very difficult.

There are plenty of opportunities to use MASINT collectors in an urban setting. Again, however, there are many more targets to monitor than there are systems. Additionally, the large human presence will create a huge number of false reports, limiting MASINT sensor effectiveness.

Intelligence dissemination in an urban setting has unique characteristics (See Figure 17). As in the mountains, the limited LOS and terrain masking make military communications difficult. Metal building structures tend to act like grounding rods, absorbing that energy, while concrete blocks reflect radio energy. Transmitters must use greater power or communications retransmission nodes to get messages through. The lack of open space makes it difficult to emplace communications systems. Though the compact nature of military operations makes communicating ranges relatively short, this is not of great benefit as radio frequency deconfliction becomes extremely difficult due to the high density of communications systems.

Urban Environment:

Impact on Intelligence Dissemination:

The terrain of manmade structures make military communications difficult. LOS is often limited demanding retransmission of messages. However, the possibility of using parts of the civilian communications structure in place can alleviate bottlenecks. Placement of communications assets difficult because of numerous buildings. The density of communications systems makes it difficult to deconflict signals. Unintended jamming occurs from unshielded power sources such as power plant or factories. The decentralized nature of combat can limit the ability to contact units.

Figure 17.

The presence of a civilian communications system, particularly telephone communications, offers the potential for passing messages over leased circuits which can handle a much higher throughput than military systems. This is especially useful for command posts, which can expect to occupy semifixed positions. The usefulness of radios is

diminished by severe terrain masking and restricted LOS which limit broadcasting ranges.

CONCLUSIONS

Terrain factors play a major role in determining the ability of the tactical intelligence system to collect and disseminate intelligence. However, the current tactical MI structure is so rigid that commanders cannot organize their intelligence assets to appropriately respond to the effects imposed by terrain and weather. Current tactical organizations for collection and dissemination remain designed for focused combat in Central Europe. The viability of the tactical intelligence structure can be improved with thoughtful reorganization (See Figure 18).

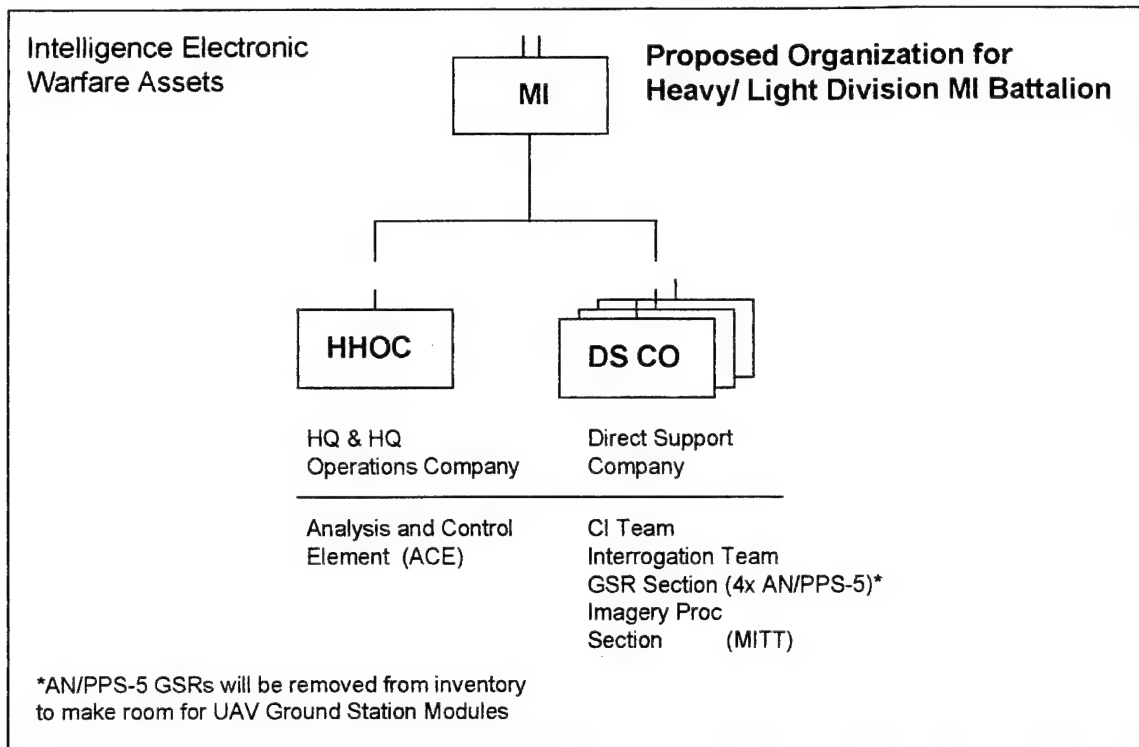


Figure 18.

The proposed divisional intelligence organization retains an MI battalion but moves collection assets to corps. Intelligence directing, planning, and processing remains in the division. Intelligence dissemination is provided by the multipurpose MSE communications system the same way it is now. The only collectors that remain are the CI and IPW interrogation personnel needed to provide the division force protection and IPW expertise. All other collection assets are moved to functional MI battalions found in an additional MI brigade at corps level (See Figure 19). The divisional analytical component and its ability to access and process data from multiple echelons would remain. Prior to deploying, the division commander would have his senior intelligence officers analyze the terrain and

determine the best mix of collectors to bring during the plan and direct phase of the intelligence cycle. He would then request the necessary assets from the functionally-based corps MI brigade.

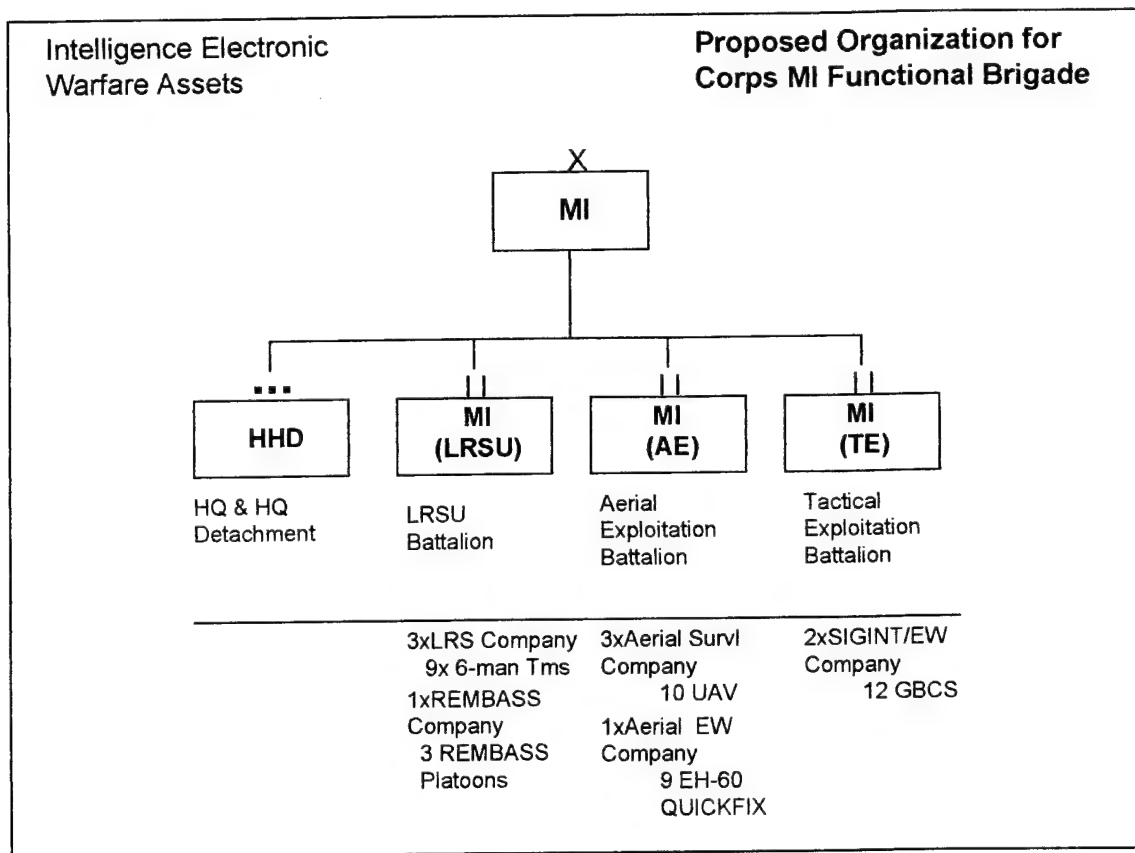


Figure 19.

The brigade would then create a tailored intelligence task force of various companies and place them under the division's operational control. With the centralizing of collectors at the corps level, MI commanders would be better able to task organize intelligence assets to take into account the impact of terrain and other factors. For example, if a heavy division was deploying into a jungle

environment, it could request more HUMINT and SIGINT assets and reduce the number of IMINT collectors. In a desert deployment the division would receive more IMINT and SIGINT collectors and very few HUMINT and MASINT collectors. Additionally, by centralizing collection assets there would be more efficient utilization and focused training.

MI brigades would control the sensors external to the division while divisions would concentrate on those collectors remaining in the division. Commanders would need to control the integration of data from three sources: the corps MI assets under his operational control, the divisional MI assets he owns, and the combat reporting of non-MI units in his division. This integration is not a hardware issue but one of staff coordination and battle tracking. Patrol debriefings, commanders situation reports, and AH-64 Apache video tapes would be better utilized by the analysts in the ACE to refine the intelligence later pushed down to subordinates.

Organizing collectors in a brigade would allow better use of the very scarce HUMINT and MASINT collectors currently available to tactical commanders. The very limited numbers, when placed against the numerous requirements for operations in urban, mountainous, or jungle terrain, often serve to unbalance the collection effort.

Finally, some simple, low-cost improvements in the dissemination system would greatly enhance current capabilities. Purchasing high speed graphic printers and

plotters for all ASAS and MITT terminals would facilitate dissemination of invaluable hard-copy products.

Additionally, commercial, ruggedized facsimile machines would serve to provide another means to pass intelligence products and should be made available to all battalions in the division.

Geographic settings have a major impact on the ability of tactical MI organizations to collect and disseminate intelligence. Current organizations have a poor terrain orientation and give commanders little ability to focus intelligence support. Changes in these organizations and improvements in staff operations would pay big dividends in providing the commander a more accurate picture of his enemy.

ENDNOTES

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²Anthony J. Cordesman and Abraham R. Wagner, Lessons of Modern War Volume III: The Afghan and Falklands Conflicts (Boulder, CO: West View Press, 1990),363.

³Field Manual (FM) 34-1, Intelligence and Electronic Warfare Operations (Washington, DC: Dept. of the Army, September, 1994),2-3.

⁴Ibid.

⁵CGSOC Manual Student Text (ST) SUPR TBABBI/TBBI EW, SIGINT I, IEW Operations and ACE/ASAS Concepts (Ft Leavenworth, KS: US Army TRADDOC, March 1994), 10.

⁶Idem, Intelligence and Electronic Warfare Operations, 2-15.

⁷Ibid.

⁸Ibid.

⁹Ibid.

¹⁰Ibid.

¹¹Ibid., 2-16.

¹²Ibid., 2-17.

¹³Ibid., 2-7

¹⁴Ibid, 2-4,2-5.

¹⁵Ibid.,2-4.

¹⁶Ibid.,2-5.

¹⁷Ibid.,4-1.

¹⁸CGSOC Student Text (ST) FB030, Fundamentals of Tactical Operations (Ft Leavenworth, KS: US Army TRADDOC, March 1994), 5-10.

¹⁹Ibid., 3-34.

²⁰Idem, SIGINT I, IEW Operations and ACE/ASAS Concepts, 71.

²¹Electro Optic intelligence is information derived from the optical monitoring of the electromagnetic spectrum from ultraviolet through far infrared. Forward Looking Infrared is an imagery system whose raster scans the scene viewed by internal means, both horizontally and vertically. Leo Carl, International Dictionary of Intelligence. (McLean, VA: International Defense Consultant Services, Inc., 1990), 122, 146.

²²Ibid., 71.

²³Idem, SIGINT I, IEW Operations and ACE/ASAS Concepts, 86-87.

²⁴Ibid., 98-99.

²⁵Side-looking airborne radar (SLAR) is an airborne radar, viewing at right angles to the axis of the vehicle, which produces a presentation of terrain and targets. Idem, International Dictionary of Intelligence, 383.

²⁶Field Manual (FM) 100-5, Operations (Washington, DC: Dept. of the Army, June 1993), 14-3.

²⁷Patrick O'Sullivan, Terrain and Tactics (Westport, CT: Greenwood Press, 1991), 121.

²⁸Idem, Lessons of Modern War Volume I, 38.

²⁹Ibid., 39.

³⁰Field Manual (FM) 34-130, Intelligence Preparation of the Battlefield (Washington, DC: Dept. of the Army, July, 1994), 2-10.

³¹Idem, Lessons of Modern War Volume I, 50, 100.

³²Department of Defense, Conduct of the Persian Gulf War, (Washington, DC: GPO, April 1992), (0-16-038094-4), 346

³³Richard J. Quirk III, Intelligence for the Division: A G-2 Perspective, US Army War College (Carlisle Barracks, PA: 1992), 271.

³⁴Idem, Conduct of the Persian Gulf War, 342-343.

³⁵Idem, Conduct of the Persian Gulf War, 346.

³⁶Idem, Terrain and Tactics 33.

³⁷Ibid. 24.

³⁸Idem, Operations, 14-3.

³⁹John Prados, The Hidden History of the Vietnam War (Chicago, IL: Ivan R. Dee, 1995), 195.

⁴⁰Idem, Operations, 14-3.

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